February 26, 1998

To: Klamath Fishery Management Council

From: Klamath River Technical Advisory Team

Subject: Brood Year 1992 Shasta River fall chinook.

Abstract

The ratio of age-4 to age-3 spawners of Shasta River fall chinook from the 1992 brood year (BY) was abnormally small. This report investigates potential factors that resulted in this ratio. A binary tree model is presented to represent the factors that may have influenced the survival of this cohort from age three in the ocean until the time of spawning at ages 3 and 4. Analysis of available data indicate it is likely that several factors substantially influenced the small age-4 to age-3 ratio, including: (1) a high age-3 maturation rate for the 1992 Shasta River BY (2) a larger inriver harvest rate at age-4 than age-3, as a result of substantially under-predicted age-3 stock abundance (3) potentially greater inriver non-fishery related mortality or straying of age 4 fish during 1996, as a result of mainstem Klamath water temperatures that were warmer than in 1995 (both years were above optimal migration ranges for chinook). Assessment of the Iron Gate Hatchery fingerling 1992 BY escapement rate, ocean harvest rates and inriver harvest rates indicate that the harvest management objectives for Klamath-Trinity fall chinook were met for the 1992 BY of Shasta River fall chinook.

At the October Klamath Fishery Management Council (KFMC) meeting, the Klamath River Technical Advisory Team (KRTAT) was directed to further investigate three hypothesis made by the Shasta River CRMP in a letter dated February 26, 1997 regarding the small ratio of age-4 to age-3 spawners from the Shasta River fall chinook 1992 brood year (BY). The KRTAT assumes that the three hypothesis to be addressed are actually the three questions raised by the CRMP on page 2 of their February 26 correspondence, which are:

1. What became of the remainder of the Brood Year (BY) from the Shasta River between the spawner run of 1995 and the spawner run of 1996?
2. Did the same thing happen elsewhere in the Klamath Basin?
3. How often has this occurred?

As indicated by the graphs presented in the CRMP's letter of February, 1997, the ratio of age-4 to age-3 Shasta River 1992 brood year fall chinook returns appears to be abnormally small (Figure 1). This ratio is influenced by several factors, such as age 3 and 4 maturation rates, age-3 and 4 inriver fishery impact rates, age-3 and 4 non-fishery related inriver mortality and homing success rates, and the age-4 ocean fishery impact rate.

In this report, the KRTAT attempts to respond to the three questions by isolating specific parameters which may have resulted in seemingly anomalous returns at age for BY 1992. The binary tree model in Figure 2 represents the Shasta River 92 BY cohort, beginning with the age-3 ocean fishery survivors. The lower-case letters on each branch represent the corresponding rates (0-1) for the events depicted. The fraction of the ocean age-3 population that survives to any particular stage is the product of the individual rates on the branches leading to that stage. The formulas below the model apply these rates to represent the age 3 and 4 escapement of Shasta BY 1992 fall chinook. The age 4 to 3 ratio is then presented to illustrate the effect of each rate. For each component rate, it is stated whether it would have to be unusually large or small for the ratio of 4's to 3's to be unexpectedly small.

The following analysis examines the data available to investigate factors that could have affected the above mentioned rates for the 1992 Shasta BY.

Maturation Rate

An unusually large age- 3 maturation rate would result in an unexpectedly small ratio of age-4 to age-3 fall chinook escapement for a particular BY. Shasta River 1992 BY fall chinook may have matured primarily at age-3 for the following reasons: (1) analysis of historic data from the Shasta racks indicate Shasta River fall chinook life history may have been characterized by predominant maturation at age-3, (2) pulse flows in the Shasta River during the spring of 1993 may have contributed to an anomalously larger age-3 maturation rate, (3) 1992 BY Iron Gate Hatchery fingerling fall chinook, which is the hatchery stock that is thought to most closely represent Shasta River fall chinook, had an unusually high age-3 maturation rate.

1) Analysis of counts at the Shasta River racks indicate that historically Shasta River fall chinook may have primarily matured at age-3. From 1931 to 1960 there existed a fairly strong linear relationship ($R^2 = 0.80$, Figure 3) between the number of jacks (age two chinook) counted in one year and the number of adults counted the following year. The relationship between jacks one year and adults the next is likely the result of brood year abundance, which indicates the primary age composition of adults was age-3. For reasons unknown, this relationship ceased to exist after the early 1960's (Figures 4 and 5). Perhaps environmental factors, such as good ocean conditions, caused this age 3 maturation rate to reoccur for the 1992 BY.

2) In the KRTAT's memo to the KFMC dated 29 Septmember, 1997 it was mentioned that the spring of 1993 was the first time that water diversions were decreased for 1-2 days and subsequently flows were increased in an attempt to flush juvenile chinook salmon out of the river before water quality became unsuitable for salmonids. Several studies have found a relationship between the size of juvenile salmonid smolts and their subsequent age at maturation (Bilton et al. 1982, Power 1986, Ritter et al. 1986) We speculated that the early flushing of the juveniles into the mainstem Klamath River led to

accelerated juvenile growth which may have had an effect on their age of maturation, causing a larger proportion to mature at age-3.

Dave Webb, of the Shasta River CRMP, responded in a letter to the KFMC dated October 2, 1997 that "forcing smolts from the Shasta, where food and rearing conditions (excepting temperature and D.O.) are good, into the Klamath, where none of the above are good, doesn't seem likely to increase their size at entry to the ocean." However, it is possible that early exit from the Shasta resulted in earlier estuarine entry, which resulted in larger size at entry to the ocean.

3) Coded wire tag information needed to reconstruct the cohort of a particular stock is lacking for Klamath Basin wild fall chinook populations, so information from Iron Gate Hatchery fingerlings is used to represent wild populations of the Basin. Fingerlings are used as a surrogate for natural stocks because the majority of the natural production emigrates from natal streams as fingerlings. Due to the relative proximity of the Shasta River to IGH, life history traits of the two populations may be more similar than between populations farther from the hatchery. The IGH fingerling fall chinook 1992 BY had an unusually high age-3 maturation rate of 60%, which is 50% higher than the 1979 - 1992 average of 40% (Figure 6). It is likely the environmental factors that caused IGH fingerlings to primarily mature at age 3 in 1995 also influenced the Shasta population.

An unusually small age-4 maturation for the 1992 brood year would have also contributed to a small age 4 to age 3 ratio. However, this is unlikely because the age-4 maturation rate for the 1992 BY of IGH fingerlings was not small (96.4%) relative to the mean maturation rate (94%) of IGH fingerlings since 1979.

Ocean Fishery Impacts at Age 4

There are no data available to determine whether Shasta River fall chinook are harvested at a different rate in the ocean than other Klamath Basin stocks. Assuming that the various Klamath Basin stocks are harvested in the ocean at approximately the same rate, it is unlikely that ocean fisheries contributed to the small age-4 to age-3 spawner escapement ratio. The age-4 ocean harvest rate was actually larger during 1995 (21%) than 1996 (16%).

Inriver Fishery Impacts

It is likely that inriver fisheries had some effect on the small ratio of age-4 to age-3 spawners, because the abundance of returning fall chinook in 1995 (when fish were returning at age-3) was grossly under-predicted, however the abundance was more accurately predicted in 1996 (when fish were returning at age-4). During 1995, fisheries were constrained to meet the minimum spawning escapement level, however approximately 213,700 adults returned to the river, which is the largest run of adults on record (since 1978). As a result of under prediction, a large number of fish (that preseason would have been considered harvestable surplus) were allowed to spawn.

During 1996, approximately 229,000 fish were predicted to return to the river and the post-season abundance was approximately 175,000 adults. It is noteworthy that while inriver fisheries were allocated approximately 125,000 adults during 1996, their actual harvest was approximately 69,200 adults.

To assess the effect of inriver harvest on the small ratio of age-4 to age-3 Shasta returns the following factors have been investigated: (1) the run timing of Shasta River fall chinook, (2) coded wire tag recoveries from the Yurok Tribal fishery, (3) brood escapement rates and the inriver harvest impact rate for IGH fingerlings.

1) Run Timing

It has been postulated that inriver fisheries may have disproportionately harvested age-4 Shasta River fall chinook during 1996 because the Shasta is thought to have one of the earliest spawning runs in the Klamath. In the KRTAT's 29 September, 1997 memo to the KFMC, the similarity of the river entry timing of IGH fall chinook to that of Shasta River fall chinook was addressed. Natural fish from the Shasta River were tagged from 1983 - 1987 and recovered in the Yurok fishery from 1987 - 1989. Analysis of these recoveries (Appendix A) failed to show significantly different run timing between Shasta River and IGH fall chinook. During each of the recovery years, IGH fall chinook were being recovered in the Yurok fishery one to two weeks prior to the recovery of the first Shasta River fall chinook. During 1987 there were 70 IGH tags recovered prior to the recovery of the first Shasta River tag, in 1988 there were 88 IGH tags recovered prior to recovery of the first Shasta River tag and in 1989 there were 12 IGH tags recovered prior to recovery of the first Shasta River tag. During the entire time period that Shasta River tags were being recovered, there were 1399 IGH and 21 Shasta River tags recovered in 1987, 535 IGH and 6 Shasta River tags recovered in 1988 and 1618 IGH and 28 Shasta River tags recovered in 1989. Thus, available data shows that river entry for Shasta chinook is comparable to that for IGH chinook.

2) Yurok CWT Recoveries

In Dave Webb's 2 October, 1997 memo to the KFMC, he suggested that to investigate whether any fishery was capturing large numbers of discrete groups of wild salmon, one could look at the daily coded wire tag recoveries from a fishery to determine whether there were days of large harvest early in the run where there were large changes in the ratio of hatchery to wild salmon. The Yurok Tribe has provided such an analysis of CWT recoveries from their 1996 estuary fishery, which is where more than 90% of the Yurok fall chinook harvest occurred during 1996. During 1996, Yurok Tribal harvest accounted for approximately 78% of inriver adult fall chinook harvest.

The Shasta CRMP requested daily CWT recoveries from the Yurok fishery to investigate the above mentioned hypothesis. However, sampling expansions to account for the proportion of harvest that is examined for CWTs in the Yurok fishery are determined for weekly time periods. Other fisheries use similar or larger time frames to make sampling expansions. To comply with the CRMP's request of daily CWT recoveries, daily CWT recoveries were expanded by the appropriate weekly expansion factor. A problem with

examining CWT recoveries during such a small time period is that erroneous results can occur, especially during periods of minimal harvest. For example, expansions indicate that 129% of the Yurok harvest on August 23 was from fish with CWTs.

Analysis of the Yurok CWT recoveries does not indicate a large change in ratio of hatchery to wild fish early in the fall chinook run on days of large harvest (Figures 7 -10). On most days that substantial fall chinook harvest occurred (e.g. more than 1,000 fall chinook) the estimated proportion of harvest that was of IGH or TRH origin ranged between 17 - 23%. According to the 1997 cohort reconstruction model of the Klamath River Technical Advisory Team, approximately 21% of the 1996 fall chinook run was represented by IGH or TRH CWTs (according to the mega-table, 20% of the run returned to IGH or TRH).

An exception may be on August 30, when approximately 3800 fall chinook were harvested by the Tribe and only 10% were of hatchery origin. However, the apparent disproportionate harvest of wild fish on this day equates to about 400 fish, which does little to explain the small age-4 to age-3 ratio. Since it was suggested to look at the early part of the run, it is noteworthy that three days earlier (August 27), 19% of the 3900 fall chinook harvest was of hatchery origin.

3) IGH Fingerling Escapement and Harvest Rates

As discussed previously, information obtained from IGH fingerling CWT recoveries is used to represent wild populations of the Klamath Basin. Because of the proximity and similar run timing of Shasta River fall chinook to IGH this may be more appropriate for the Shasta River than with some other wild stocks in the basin. Therefore, the brood escapement rate and harvest rate of the 1992 BY IGH fingerlings have been analyzed, assuming that these rates were similar for the Shasta River 1992 BY fall chinook.

The Pacific Fishery Management Council's Framework Plan (Amendment 9) requires that Klamath fall chinook be managed to achieve an escapement rate for each brood of between 33 and 34 percent. At low stock sizes, the plan calls for escapement of 35,000 adult natural spawners, regardless of escapement rate. The escapement rate for the 1992 BY IGH fingerlings was approximately 67% (Figure 11) and the 35,000 natural spawning floor was exceeded during both years (1995 and 1996) that age 3 and 4 adults from this brood were returning. Thus, the escapement mandates of Amendment 9 were largely exceeded for the 1992 BY of Klamath fall chinook and for IGH fingerlings, which may serve as a surrogate for Shasta River fall chinook.

In order to meet brood year escapement rates of 33 to 34 percent, long term equilibrium harvest rates on age-4 fish of 20% in the ocean and 66.5% in the river should be met on an annual basis over the long term. The inriver harvest impact rate on age 4 Iron Gate Hatchery fingerlings (which represent Shasta River fall chinook) was 21% during 1995 and 62% during 1996. This disparity is largely due to the above mentioned under-prediction of the 1995 run size. While this disparity of inriver harvest rates contributes to

the small age-4 to age-3 ratio, it is noteworthy that the 62% inriver harvest of IGH fingerlings is below the target harvest rate mandated by Amendment 9 of the Pacific Fishery Management Council's Framework Plan.

Inriver Mortality and Homing Success

In the KRTAT's September 29, 1997 memo to the KFMC, it was mentioned that the Klamath River has substantial quantities of water diverted for agricultural purposes, resulting in summer water temperatures that may be lethal to salmonids. The KRTAT speculated that if water temperatures were warmer during August and early September of 1996 than in 1995, then there may ~~by many~~ have been excessive mortality or straying of adult fall chinook returning to the Shasta River during 1996. However, at the time, there was no Klamath River water temperature data available for 1995.

Data recently obtained regarding water temperatures in the mainstem Klamath River during 1996 (Diaz, unpublished data) and 1995 (Karuk Tribe, 1997) indicate the river was warmer during August of 1995 than 1996 (Figures 12 and 13). During 1995, daily average water temperatures in the mainstem Klamath River below the Shasta River began dipping below 70^0 F on about August 8, however average daily water temperatures did not get this cool until about September 3 in 1996. According to Bell (1991), fall chinook salmon optimal migration range is from 51 - 67^0 F. Any impact the warmer water temperatures may have had on returning Shasta River fall chinook during 1996 would affect the age-4 to age-3 ratio of the 1992 BY.

Literature Cited

Bell, M.C. 1986. Fisheries handbook of engineering requirements and biological criteria. Fish passage development and evaluation program, Corps of Engineers, North Pacific Division, Portland Or. 290p.

Bilton, H.T., D.F. Alderdice, and J.T. Schnute. 1982. Influence of time and size at release of juvenile coho salmon (*Oncorhynchus kisutch*) on returns at maturity. Can. J. Aquat. Sci. 39 39: 426-447.

Karuk Tribe, 1997. Water temperature monitoring of the Klamath River mainstem. Progress Report #4. Availabe from the Karuk Tribe, Department of Natural Resources, P.O. Box 282, Orleans CA, 95556

Power G. 1986. Physical influences on age at maturity of Atlantic salmon (*Salmo salar*): A synthesis of ideas and questions.

Ritter, J.A., F.J. Farmer, R.K. Misra, T.R. Goff, J.K. Bailey, and E.T. Baum. 1986. Parental influences and smolt size and sex ratio effects on sea age at first maturity of Atlantic Salmon.

Figure 1. Ratio of Shasta River age 4 to age 3 escapement, Brood Years 1988 to 1992.

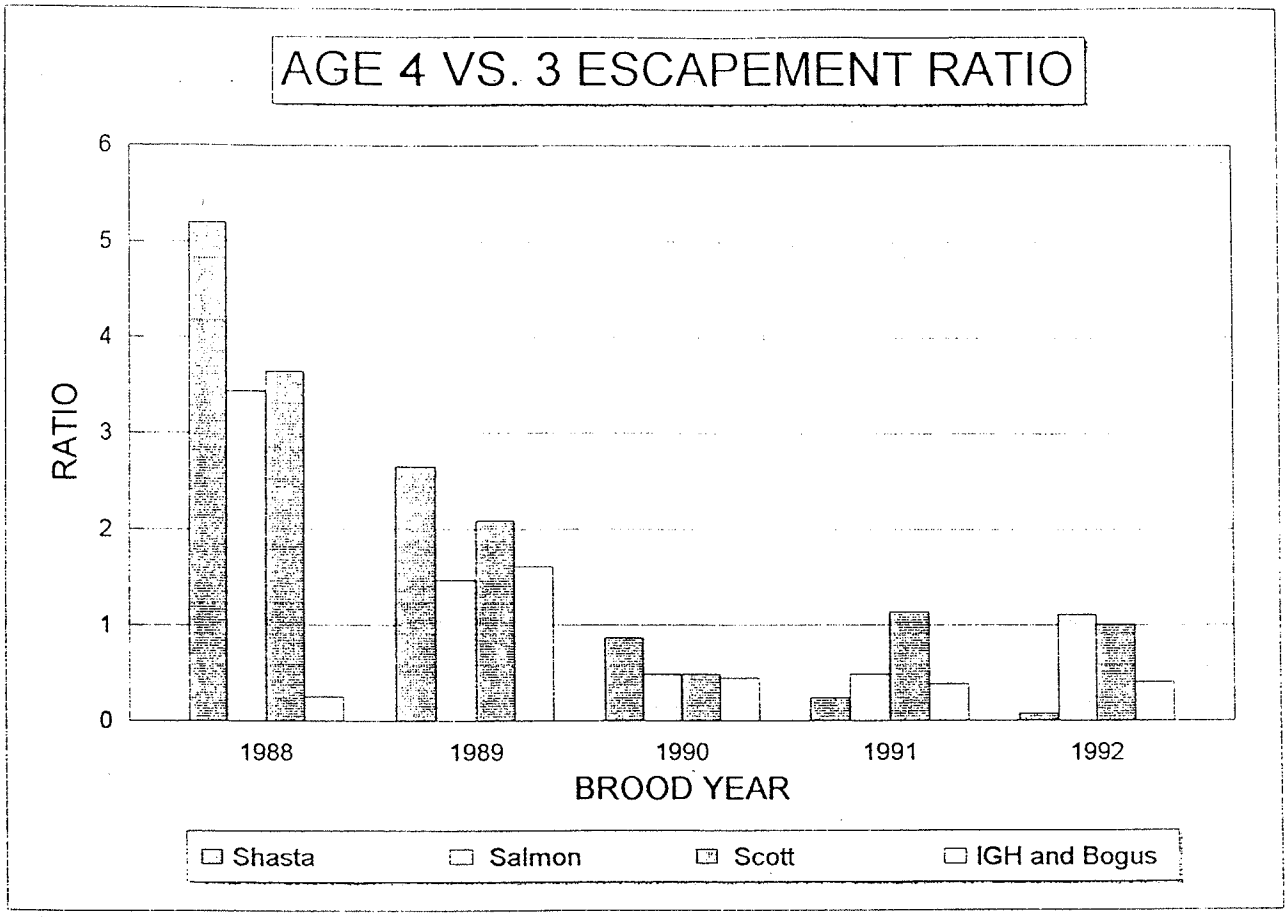
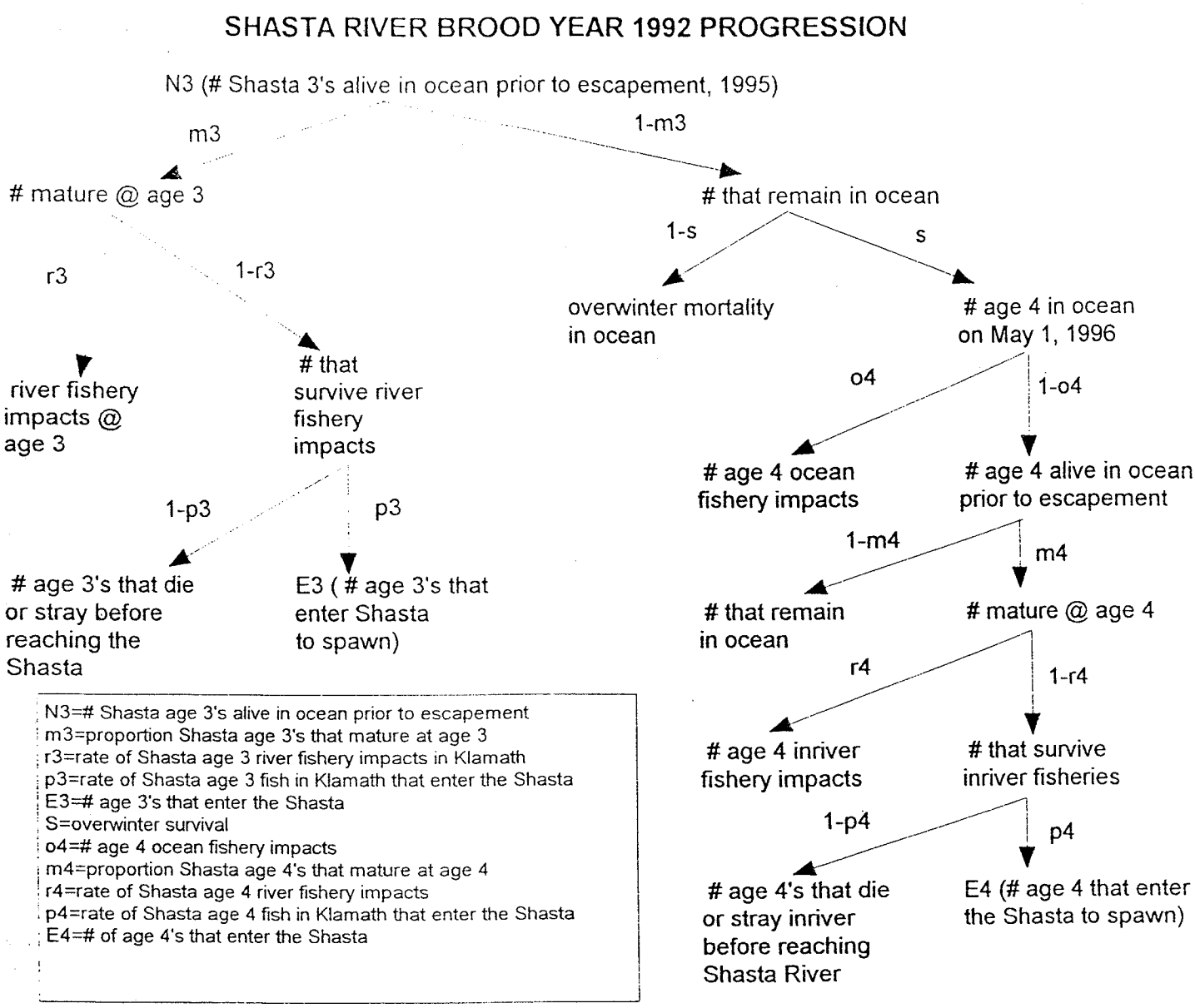


Figure 2. Binary tree model of Shasta River Brood Year 1992 progression and equations representing the age 4 to age 3 spawner ratio.



N3=# Shasta age 3's alive in ocean prior to escapement
m3=proportion Shasta age 3's that mature at age 3
r3=rate of Shasta age 3 river fishery impacts in Klamath
p3=rate of Shasta age 3 fish in Klamath that enter the Shasta
E3=# age 3's that enter the Shasta
S=overwinter survival
o4=# age 4 ocean fishery impacts
m4=proportion Shasta age 4's that mature at age 4
r4=rate of Shasta age 4 river fishery impacts
p4=rate of Shasta age 4 fish in Klamath that enter the Shasta
E4=# of age 4's that enter the Shasta

$E3 = N3m3(1-r3)p3$ $\qquad$ $E4 = N3(1-m3)S(1-o4)m4(1-r4)p4$

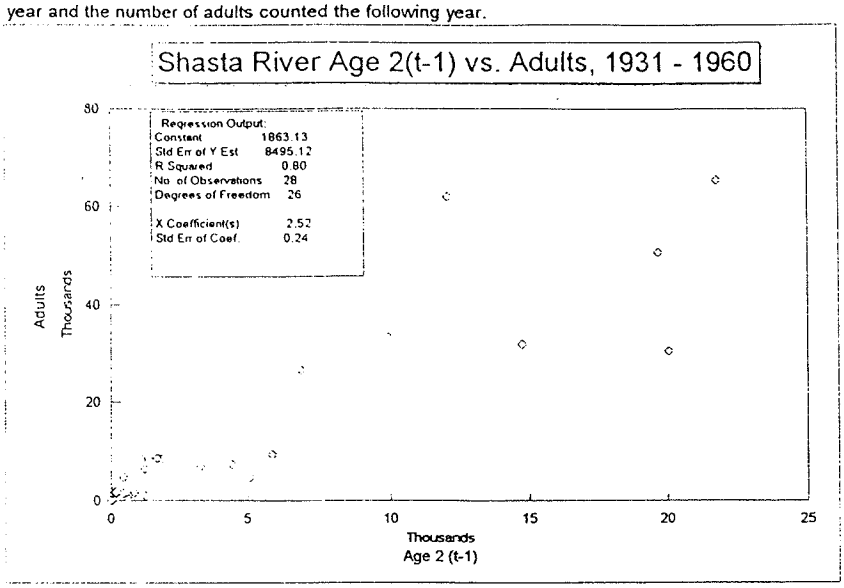
the ratio, R, of Shasta 4's to 3's is thus:

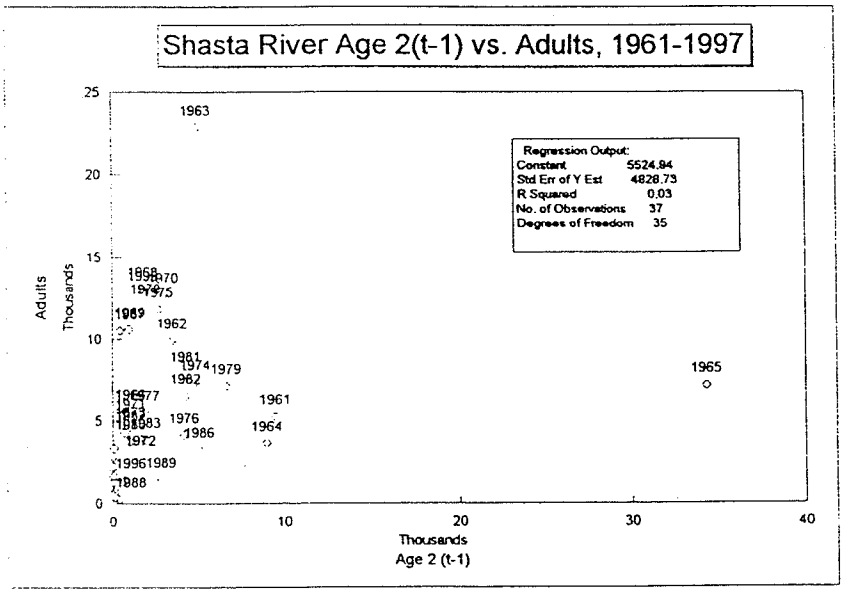
$$R = E4/E3 = \frac{(1-m3)S(1-o4)m4(1-r4)p4}{m3(1-r3)p3}$$

If "R" is unusually small for Shasta BY, it is because the numerator (E4) is unusually small or the denominator (E3) is unusually large. That is, one or more of the following ocurred :

m3 (age 3 maturation rate) was unusually large
r3 (age 3 river harvest impacts) was unusually small
p3 (age 3 homing success and survival from non-fishery river mortality) was unusually small
S (overwinter survival from age 3 to 4) was unusually small
o4 (age 4 ocean harvest rate) was unusually large
m4 (age 4 maturation rate) was unusually small
r4 (age 4 river harvest rate) was unusually large
p4 (age 4 homing success and survival from non-fishery river mortality) was unusually small

Figure 3 - 5. Relationship betweenthe number of age 2 fall chinook counted at the Shasta racks in one year and the number of adults counted the following year.





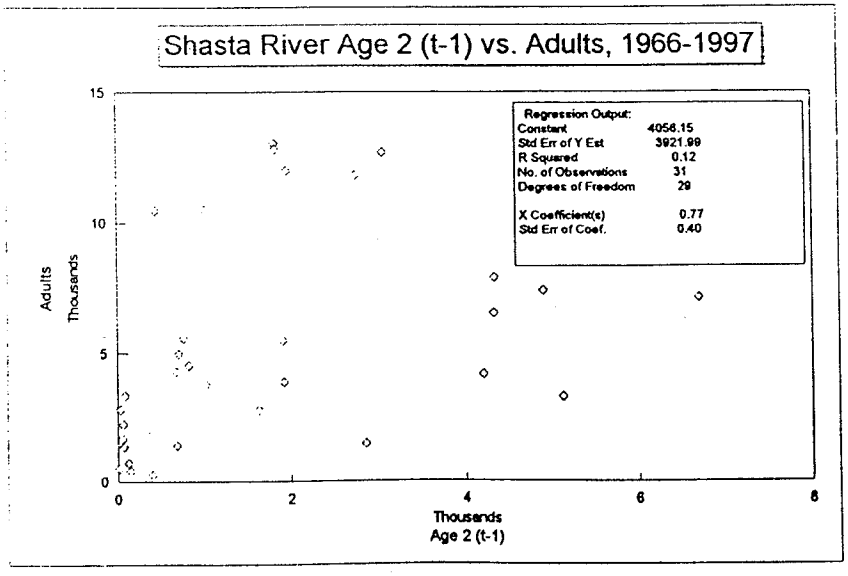
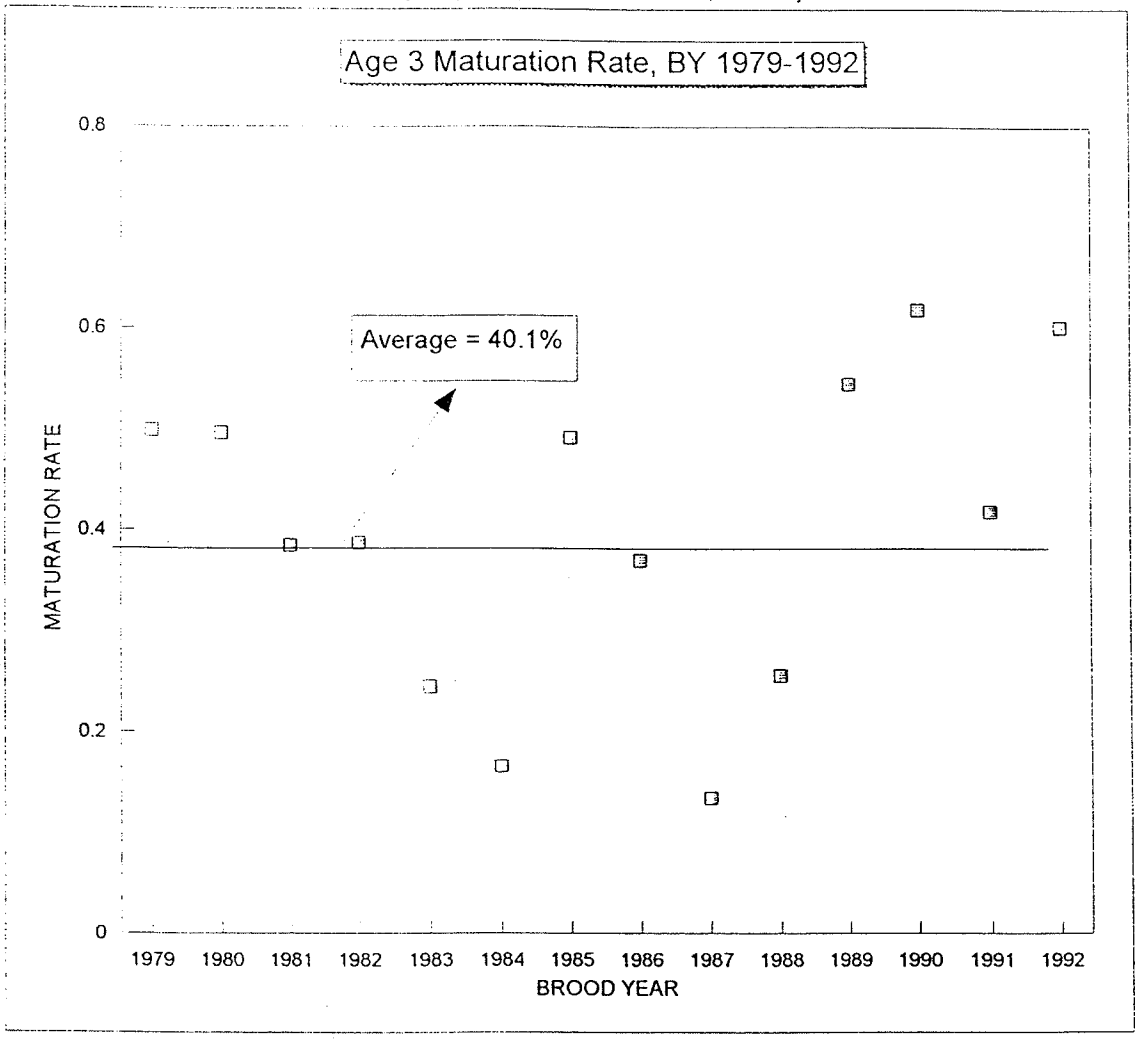
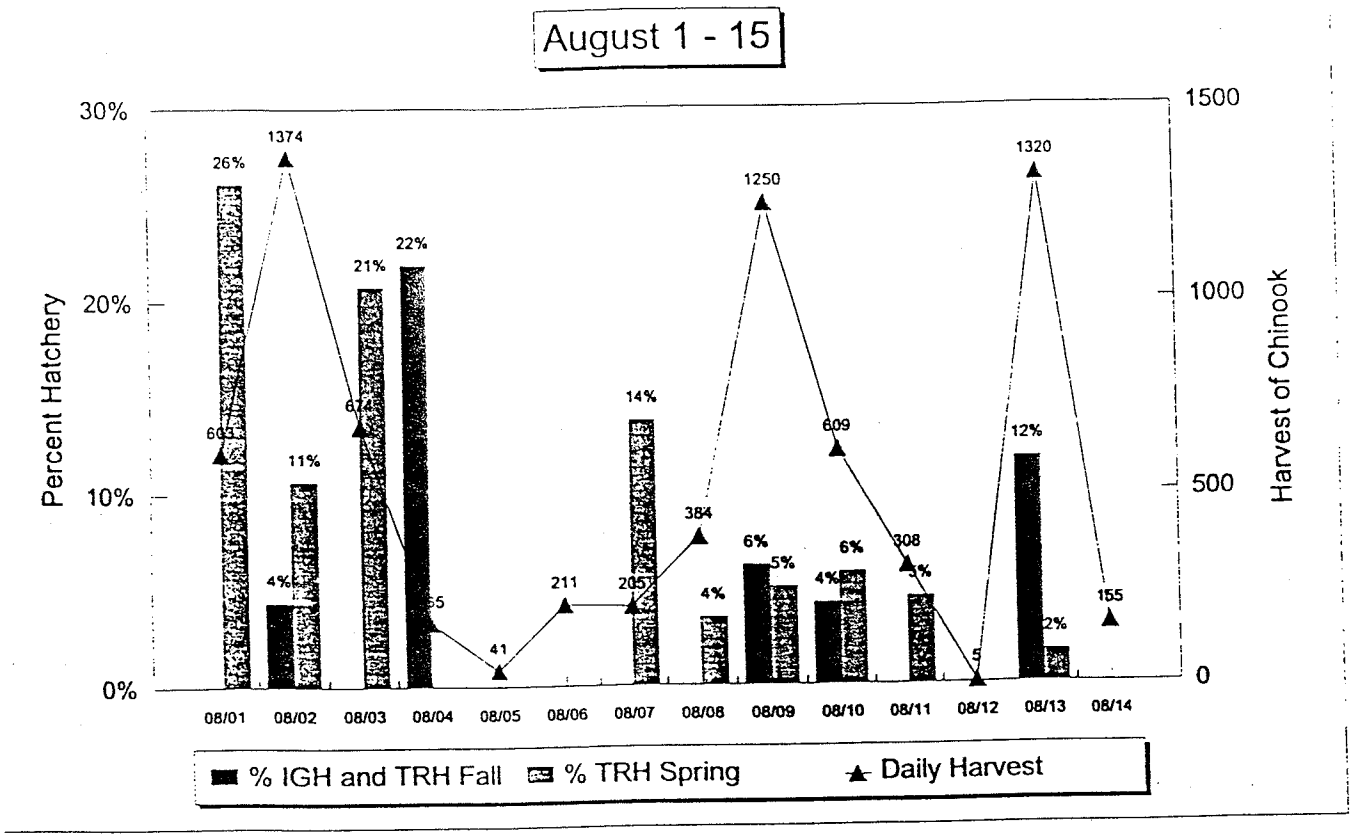
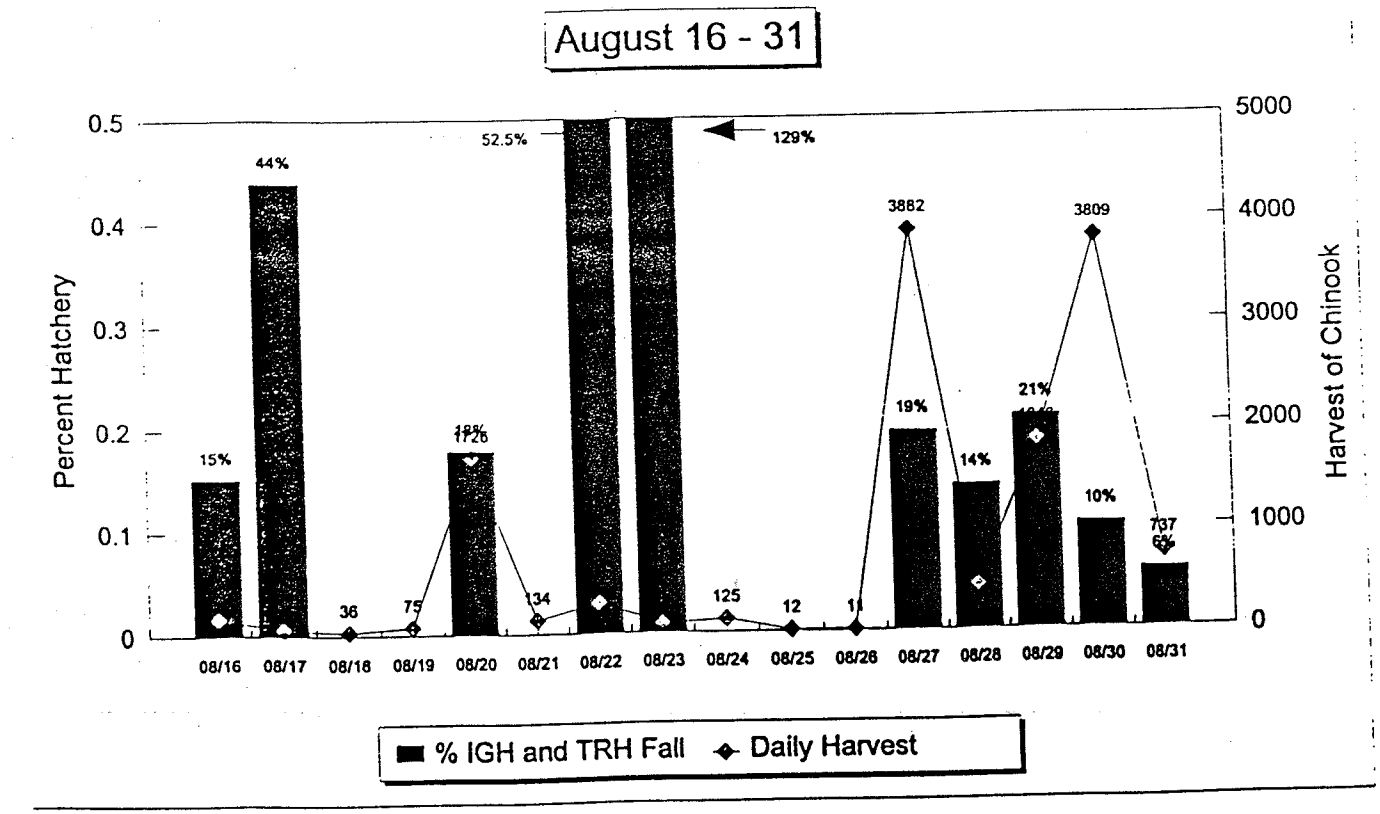


Figure 6. Age-3 Iron Gate Hatchery fingerling maturation rate, brood years 1979 - 1992.



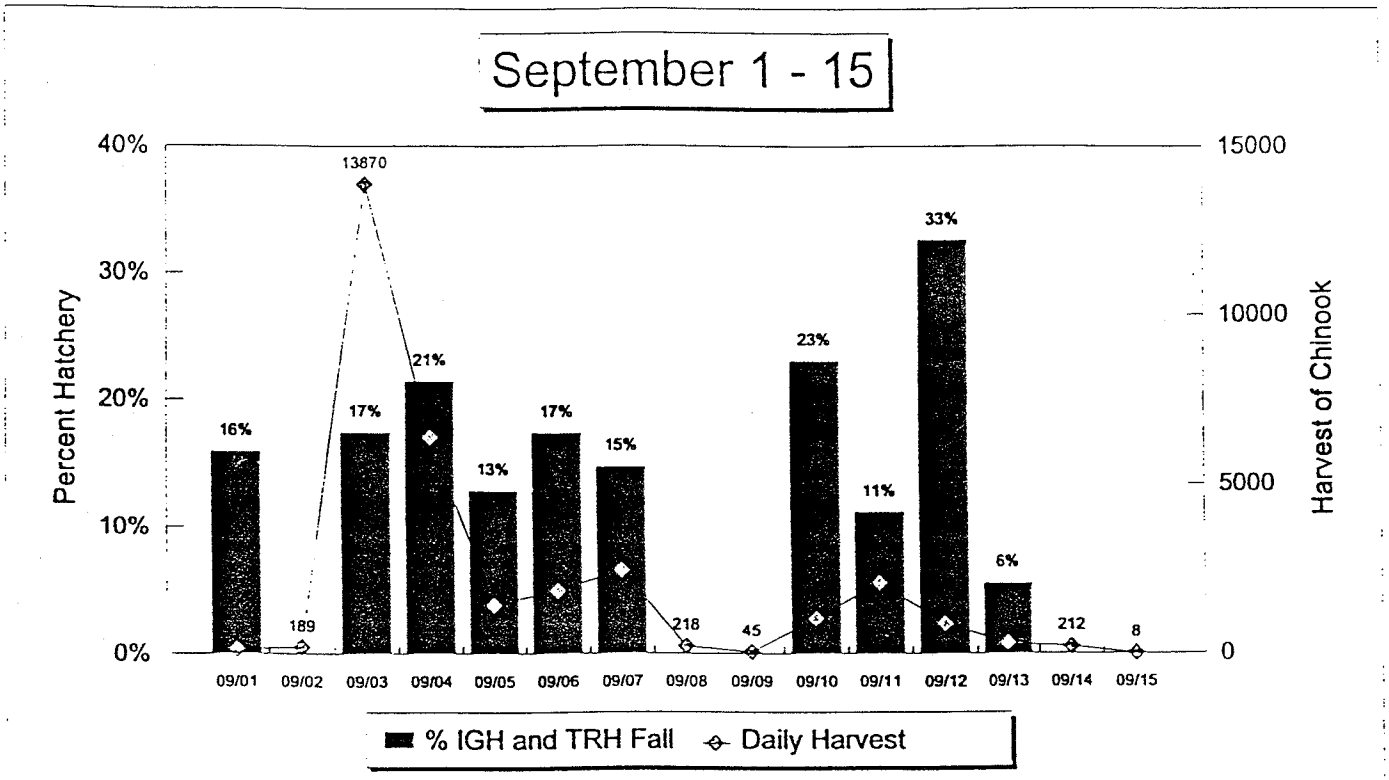
Figures 7 and 8. Daily harvest and percent of harvest that is of Iron Gate and Trinity River hatchery origin (based on CWT recoveries) in the Yurok Estuary Fishery, 1996.*

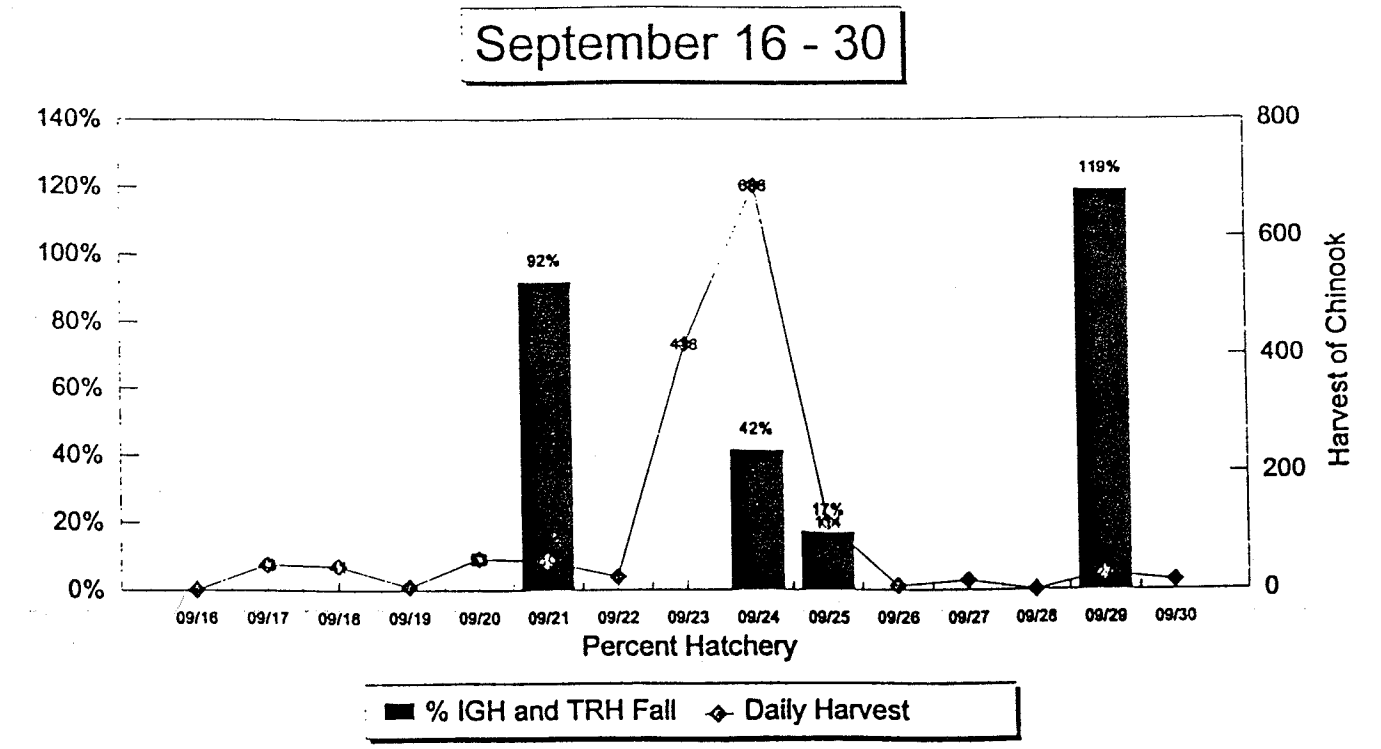




* Based upon weekly sampling expansions.

Figures 9 and 10. Daily harvest and percent of harvest that is of Iron Gate and Trinity River hatchery origin (based on CWT recoveries) in the Yurok Estuary Fishery, 1996.*





* Based upon weekly sampling expansions.

Figure 11. Iron Gate Hatchery fingerling brood year escapement rate, 1979 - 1992.

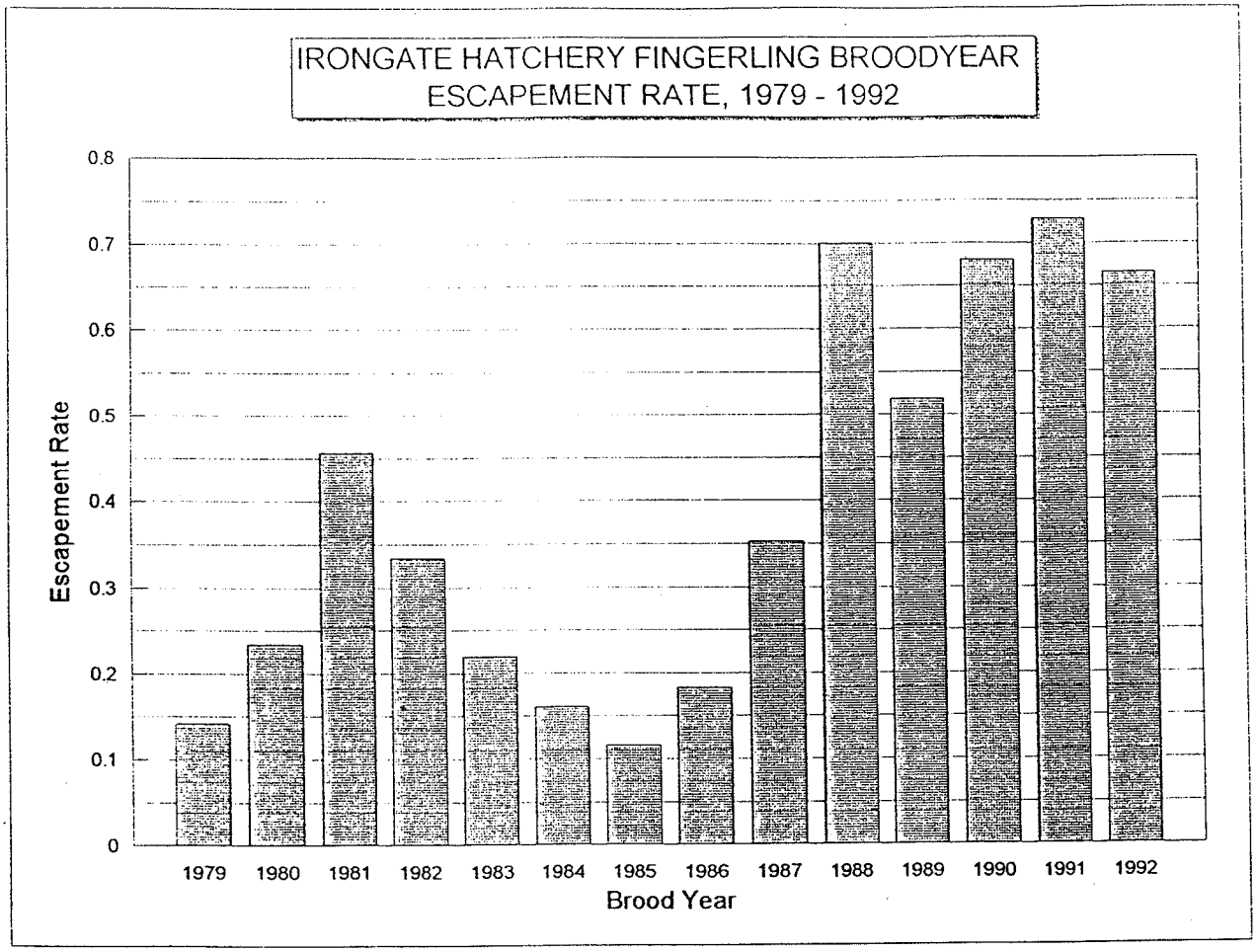
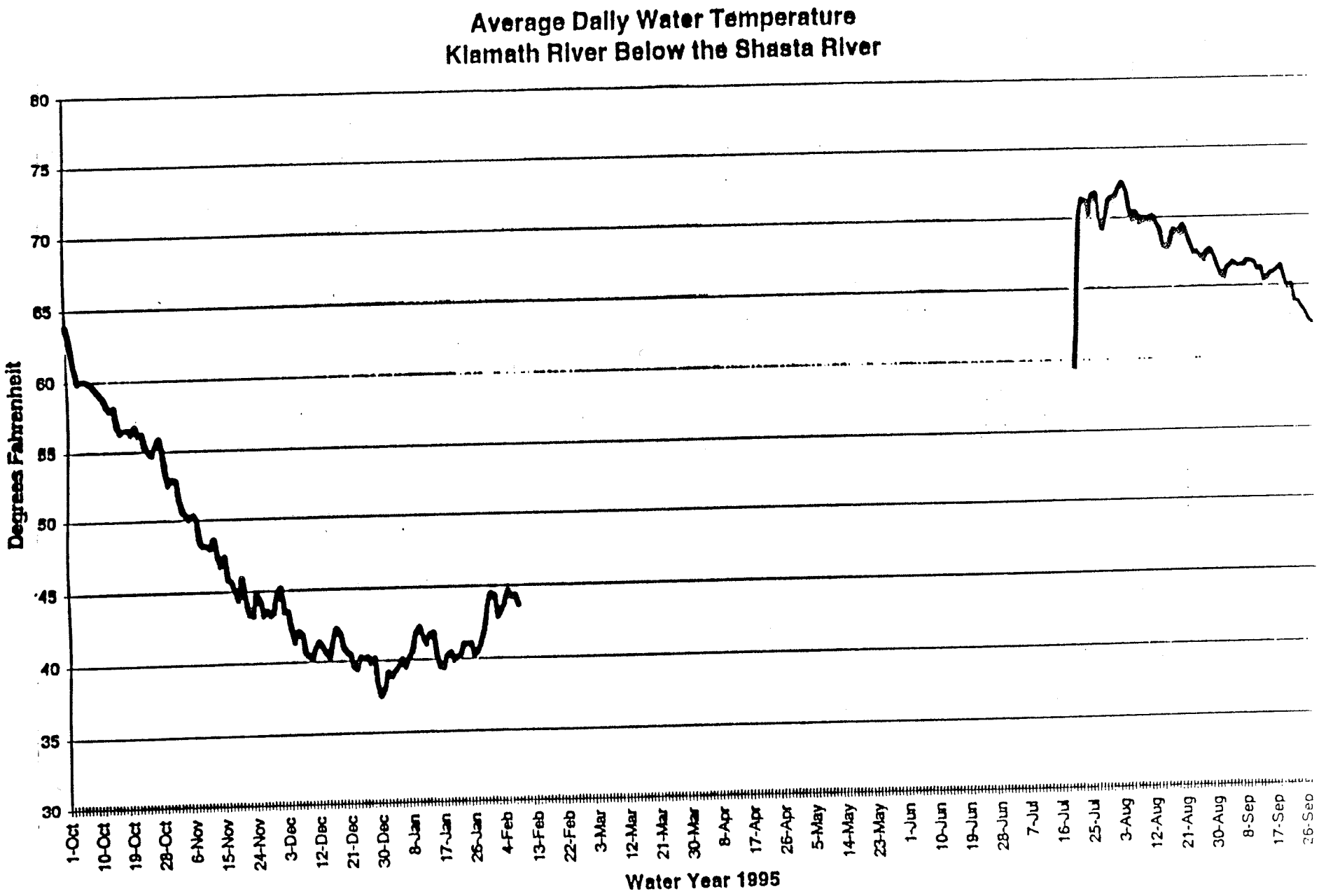
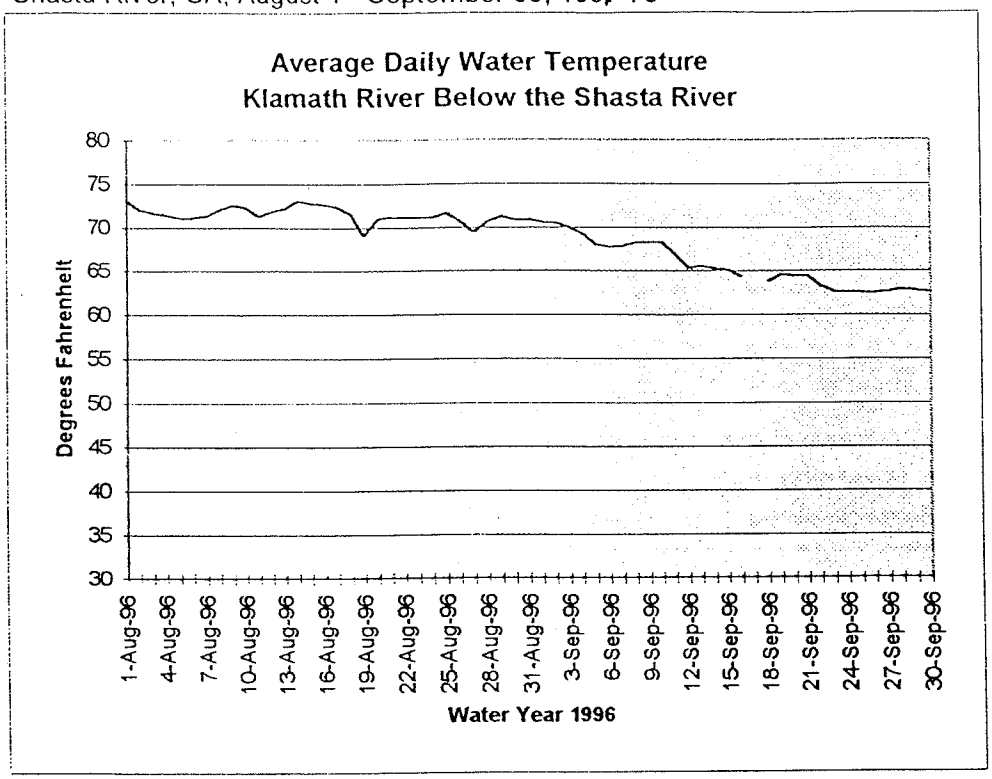


Figure 12. Average daily water temperatures in the Klamath River below the Shasta River, CA, water year 1995.*



*Data obtained from the Karuk Tribe, 1997

Figure 13. Average daily water temperatures in the Klamath River below the Shasta River, CA, August 1 - September 30, 1997*.



* Unpublished data obtained from U.C. Davis Klamath River Project

CODED WIRE TAG RECOVERIES ON THE YUROK RESERVATION, 1987

Sorted by Date

CWT Code	Date	# Caught	Stock
06-59-23	07/18/87	1	IGH
06-59-25	07/23/87	1	IGH
06-59-25	07/25/87	1	IGH
06-59-25	07/27/87	1	IGH
06-59-24	07/29/87	1	IGH
06-59-25	07/29/87	5	IGH
06-59-33	07/29/87	2	IGH
06-59-23	07/30/87	1	IGH
06-59-25	07/30/87	2	IGH
06-59-32	07/30/87	2	IGH
06-59-33	07/30/87	1	IGH
06-59-23	07/31/87	1	IGH
06-59-24	07/31/87	1	IGH
06-59-25	07/31/87	4	IGH
06-59-25	08/01/87	2	IGH
06-59-33	08/01/87	1	IGH
06-59-23	08/03/87	1	IGH
06-59-25	08/03/87	4	IGH
06-59-25	08/04/87	1	IGH
06-59-25	08/05/87	5	IGH
06-59-27	08/05/87	2	IGH
06-59-23	08/06/87	1	IGH
06-59-24	08/06/87	1	IGH
06-59-25	08/06/87	3	IGH
06-59-31	08/06/87	1	IGH
06-59-32	08/06/87	1	IGH
06-59-33	08/06/87	1	IGH
06-59-22	08/07/87	2	IGH
06-59-23	08/07/87	1	IGH
06-59-25	08/07/87	12	IGH
06-59-26	08/07/87	1	IGH
06-59-28	08/07/87	3	IGH
06-59-32	08/07/87	2	IGH
06-59-33	08/07/87	2	IGH
06-59-24	08/08/87	1	IGH
06-59-25	08/08/87	14	IGH
06-59-26	08/08/87	3	IGH
06-59-31	08/08/87	1	IGH
06-59-33	08/08/87	1	IGH
B6-09-02	08/08/87	1	SHASTA
06-59-23	08/10/87	3	IGH
06-59-24	08/10/87	5	IGH
06-59-25	08/10/87	19	IGH
06-59-26	08/10/87	4	IGH
06-59-27	08/10/87	1	IGH
06-59-28	08/10/87	1	IGH
06-59-32	08/10/87	2	IGH
06-59-33	08/10/87	7	IGH
B6-08-02	08/10/87	2	SHASTA
B6-08-04	08/10/87	1	SHASTA
06-59-22	08/11/87	2	IGH
06-59-23	08/11/87	3	IGH
06-59-24	08/11/87	2	IGH
06-59-25	08/11/87	45	IGH
06-59-26	08/11/87	4	IGH
06-59-28	08/11/87	2	IGH
06-59-31	08/11/87	3	IGH
06-59-32	08/11/87	6	IGH
06-59-33	08/11/87	7	IGH
B6-08-02	08/11/87	2	SHASTA
06-59-23	08/12/87	8	IGH
06-59-24	08/12/87	1	IGH
06-59-25	08/12/87	27	IGH
06-59-26	08/12/87	2	IGH
06-59-28	08/12/87	1	IGH
06-59-31	08/12/87	2	IGH
06-59-32	08/12/87	1	IGH
06-59-33	08/12/87	8	IGH
B6-08-03	08/12/87	2	SHASTA
B6-09-02	08/12/87	1	SHASTA
06-50-11	08/13/87	1	IGH
06-59-23	08/13/87	10	IGH
06-59-24	08/13/87	6	IGH
06-59-25	08/13/87	72	IGH
06-59-26	08/13/87	11	IGH
06-59-27	08/13/87	2	IGH
06-59-28	08/13/87	2	IGH
06-59-31	08/13/87	8	IGH
06-59-32	08/13/87	6	IGH
06-59-33	08/13/87	16	IGH
B6-08-04	08/13/87	1	SHASTA
B6-09-02	08/13/87	1	SHASTA
06-59-23	08/14/87	4	IGH
06-59-24	08/14/87	5	IGH
06-59-25	08/14/87	52	IGH
06-59-26	08/14/87	4	IGH
06-59-28	08/14/87	3	IGH
06-59-31	08/14/87	5	IGH
06-59-32	08/14/87	7	IGH
06-59-33	08/14/87	7	IGH
06-59-23	08/15/87	5	IGH
06-59-25	08/15/87	29	IGH
06-59-26	08/15/87	8	IGH
06-59-28	08/15/87	1	IGH
06-59-32	08/15/87	2	IGH
06-59-33	08/15/87	4	IGH
06-59-22	08/17/87	1	IGH
06-59-23	08/17/87	4	IGH
06-59-24	08/17/87	1	IGH
06-59-25	08/17/87	23	IGH
06-59-26	08/17/87	3	IGH
06-59-28	08/17/87	1	IGH
06-59-31	08/17/87	2	IGH
06-59-32	08/17/87	6	IGH
06-59-33	08/17/87	2	IGH
06-59-23	08/18/87	2	IGH
06-59-24	08/18/87	2	IGH
06-59-25	08/18/87	17	IGH
06-59-26	08/18/87	1	IGH
06-59-28	08/18/87	1	IGH
06-59-31	08/18/87	2	IGH
06-59-32	08/18/87	2	IGH
06-59-33	08/18/87	5	IGH
06-59-22	08/19/87	1	IGH
06-59-23	08/19/87	7	IGH
06-59-24	08/19/87	1	IGH
06-59-25	08/19/87	26	IGH
06-59-26	08/19/87	6	IGH
06-59-27	08/19/87	2	IGH
06-59-28	08/19/87	2	IGH
06-59-31	08/19/87	3	IGH
06-59-32	08/19/87	5	IGH
06-59-33	08/19/87	4	IGH

NOTE: These recoveries have not been expanded for sampling or untagged fish.

CWT Code	Date	# Caught	Stock
06-59-23	08/20/87	2	IGH
06-59-25	08/20/87	4	IGH
06-59-26	08/20/87	3	IGH
06-59-27	08/20/87	1	IGH
06-59-31	08/20/87	1	IGH
06-59-33	08/20/87	2	IGH
06-59-22	08/21/87	10	IGH
06-59-23	08/21/87	14	IGH
06-59-24	08/21/87	13	IGH
06-59-25	08/21/87	78	IGH
06-59-26	08/21/87	17	IGH
06-59-27	08/21/87	6	IGH
06-59-28	08/21/87	8	IGH
06-59-31	08/21/87	15	IGH
06-59-32	08/21/87	11	IGH
06-59-33	08/21/87	22	IGH
06-59-35	08/21/87	1	IGH
B6-08-01	08/21/87	1	SHASTA
B6-08-04	08/21/87	1	SHASTA
B6-09-02	08/21/87	2	SHASTA
06-59-08	08/22/87	1	IGH
06-59-23	08/22/87	5	IGH
06-59-24	08/22/87	5	IGH
06-59-25	08/22/87	39	IGH
06-59-26	08/22/87	16	IGH
06-59-28	08/22/87	5	IGH
06-59-31	08/22/87	3	IGH
06-59-32	08/22/87	9	IGH
06-59-33	08/22/87	13	IGH
B6-08-03	08/22/87	1	SHASTA
06-59-22	08/24/87	4	IGH
06-59-23	08/24/87	15	IGH
06-59-24	08/24/87	11	IGH
06-59-25	08/24/87	109	IGH
06-59-26	08/24/87	37	IGH
06-59-27	08/24/87	3	IGH
06-59-28	08/24/87	16	IGH
06-59-31	08/24/87	18	IGH
06-59-32	08/24/87	24	IGH
06-59-33	08/24/87	36	IGH
B6-08-01	08/24/87	1	SHASTA
B6-08-03	08/24/87	2	SHASTA
06-59-22	08/25/87	4	IGH
06-59-23	08/25/87	3	IGH
06-59-24	08/25/87	4	IGH
06-59-25	08/25/87	33	IGH
06-59-26	08/25/87	12	IGH
06-59-27	08/25/87	4	IGH
06-59-28	08/25/87	11	IGH
06-59-31	08/25/87	7	IGH
06-59-32	08/25/87	5	IGH
06-59-33	08/25/87	13	IGH
06-59-22	08/26/87	4	IGH
06-59-23	08/26/87	5	IGH
06-59-24	08/26/87	1	IGH
06-59-25	08/26/87	18	IGH
06-59-26	08/26/87	5	IGH
06-59-27	08/26/87	3	IGH
06-59-28	08/26/87	8	IGH
06-59-31	08/26/87	6	IGH
06-59-32	08/26/87	6	IGH
06-59-33	08/26/87	5	IGH
06-59-25	08/28/87	1	IGH
06-59-32	08/28/87	1	IGH
06-59-33	08/28/87	1	IGH
B6-08-03	08/28/87	1	SHASTA
06-59-25	08/29/87	2	IGH
06-59-31	08/29/87	1	IGH
B6-08-03	08/29/87	1	SHASTA
06-59-25	08/31/87	1	IGH
06-59-28	08/31/87	1	IGH
06-59-33	08/31/87	1	IGH
06-59-25	09/03/87	2	IGH
06-59-27	09/03/87	1	IGH
06-59-28	09/03/87	1	IGH
06-59-31	09/03/87	1	IGH
06-59-32	09/03/87	2	IGH
06-59-26	09/05/87	2	IGH

NOTE: These recoveries have not been expanded for sampling or untagged fish.

CODED WIRE TAG RECOVERIES ON THE YUROK RESERVATION, 1988

CWT Code	Date	# Caught	Stock	CWT Code	Date	# Caught	Stock
06-59-28	07/17/88	1	IGH	06-59-35	08/12/88	1	IGH
06-59-27	07/24/88	1	IGH	06-63-04	08/12/88	1	IGH
06-59-28	07/27/88	1	IGH	06-63-05	08/12/88	1	IGH
06-59-28	07/28/88	1	IGH	06-63-18	08/12/88	2	IGH
06-59-28	07/30/88	1	IGH	06-59-22	08/13/88	6	IGH
06-59-22	08/01/88	16	IGH	06-59-27	08/13/88	1	IGH
06-59-23	08/01/88	1	IGH	06-59-28	08/13/88	3	IGH
06-59-27	08/01/88	9	IGH	06-59-33	08/13/88	1	IGH
06-59-28	08/01/88	13	IGH	06-59-34	08/13/88	3	IGH
06-59-34	08/01/88	2	IGH	06-59-35	08/13/88	2	IGH
06-59-22	08/03/88	5	IGH	06-59-22	08/15/88	27	IGH
06-59-25	08/03/88	1	IGH	06-59-27	08/15/88	4	IGH
06-59-27	08/03/88	3	IGH	06-59-28	08/15/88	19	IGH
06-59-28	08/03/88	4	IGH	06-59-29	08/15/88	2	IGH
06-59-34	08/03/88	1	IGH	06-59-31	08/15/88	2	IGH
06-59-35	08/03/88	1	IGH	06-59-32	08/15/88	2	IGH
06-59-22	08/05/88	3	IGH	06-59-33	08/15/88	1	IGH
06-59-27	08/05/88	2	IGH	06-59-34	08/15/88	5	IGH
06-59-28	08/05/88	1	IGH	06-59-35	08/15/88	3	IGH
06-59-22	08/06/88	5	IGH	06-63-02	08/15/88	1	IGH
06-59-25	08/06/88	1	IGH	06-63-03	08/15/88	1	IGH
06-59-27	08/06/88	7	IGH	06-63-05	08/15/88	1	IGH
06-59-28	08/06/88	6	IGH	06-63-08	08/15/88	1	IGH
06-59-35	08/06/88	2	IGH	06-63-09	08/15/88	2	IGH
06-59-22	08/08/88	13	IGH	06-63-18	08/15/88	2	IGH
06-59-24	08/08/88	1	IGH	06-59-22	08/16/88	25	IGH
06-59-27	08/08/88	5	IGH	06-59-27	08/16/88	10	IGH
06-59-28	08/08/88	6	IGH	06-59-28	08/16/88	26	IGH
06-59-31	08/08/88	1	IGH	06-59-29	08/16/88	2	IGH
06-59-34	08/08/88	1	IGH	06-59-33	08/16/88	1	IGH
06-63-02	08/08/88	1	IGH	06-59-34	08/16/88	5	IGH
06-63-07	08/08/88	1	IGH	06-59-35	08/16/88	4	IGH
B6-08-06	08/08/88	1	SHASTA	06-63-03	08/16/88	1	IGH
06-59-22	08/09/88	16	IGH	06-63-04	08/16/88	1	IGH
06-59-27	08/09/88	5	IGH	06-63-05	08/16/88	1	IGH
06-59-28	08/09/88	19	IGH	06-63-09	08/16/88	1	IGH
06-59-29	08/09/88	1	IGH	06-63-18	08/16/88	1	IGH
06-59-34	08/09/88	2	IGH	06-59-22	08/17/88	40	IGH
06-59-35	08/09/88	1	IGH	06-59-23	08/17/88	1	IGH
B6-08-03	08/09/88	1	SHASTA	06-59-25	08/17/88	2	IGH
06-59-22	08/10/88	15	IGH	06-59-27	08/17/88	14	IGH
06-59-27	08/10/88	3	IGH	06-59-28	08/17/88	15	IGH
06-59-28	08/10/88	11	IGH	06-59-29	08/17/88	3	IGH
06-59-34	08/10/88	4	IGH	06-59-32	08/17/88	1	IGH
06-59-35	08/10/88	2	IGH	06-59-34	08/17/88	8	IGH
06-63-05	08/10/88	1	IGH	06-59-35	08/17/88	4	IGH
06-63-09	08/10/88	1	IGH	B6-08-03	08/17/88	2	SHASTA
06-59-22	08/11/88	11	IGH	06-59-22	08/18/88	4	IGH
06-59-23	08/11/88	1	IGH	06-59-27	08/18/88	1	IGH
06-59-27	08/11/88	5	IGH	06-59-28	08/18/88	3	IGH
06-59-28	08/11/88	8	IGH	06-59-29	08/18/88	1	IGH
06-59-34	08/11/88	1	IGH	06-59-31	08/18/88	1	IGH
06-59-35	08/11/88	1	IGH	06-59-34	08/18/88	1	IGH
06-63-03	08/11/88	1	IGH	06-59-35	08/18/88	3	IGH
06-63-18	08/11/88	1	IGH	B6-08-03	08/18/88	1	SHASTA
B6-08-03	08/11/88	1	SHASTA	06-59-22	08/22/88	1	IGH
06-59-22	08/12/88	14	IGH	06-59-28	08/22/88	1	IGH
06-59-25	08/12/88	1	IGH	06-59-34	08/22/88	1	IGH
06-59-27	08/12/88	3	IGH	06-59-22	08/23/88	1	IGH
06-59-28	08/12/88	8	IGH	06-59-22	08/24/88	1	IGH
06-59-29	08/12/88	1	IGH	06-59-28	08/24/88	1	IGH
06-59-34	08/12/88	1	IGH				

NOTE: These recoveries have not been expanded for sampling or untagged fish.

CODED WIRE TAG RECOVERIES ON THE YUROK RESERVATION, 1989

CWT Code	Date	# Caught	Stock	CWT Code	Date	# Caught	Stock
06-59-34	07/30/89	1	IGH	06-63-04	08/13/89	10	IGH
06-63-08	07/31/89	1	IGH	06-63-05	08/13/89	14	IGH
06-59-29	08/01/89	1	IGH	06-63-06	08/13/89	8	IGH
06-63-09	08/01/89	1	IGH	06-63-07	08/13/89	18	IGH
06-59-29	08/02/89	1	IGH	06-63-08	08/13/89	18	IGH
06-63-03	08/02/89	1	IGH	06-63-09	08/13/89	18	IGH
06-63-18	08/02/89	1	IGH	06-63-18	08/13/89	16	IGH
06-59-29	08/03/89	1	IGH	06-63-32	08/13/89	4	IGH
06-63-05	08/04/89	1	IGH	B6-08-10	08/13/89	4	SHASTA
06-59-29	08/05/89	3	IGH	06-59-22	08/16/89	2	IGH
06-59-27	08/09/89	4	IGH	06-59-27	08/16/89	4	IGH
06-59-28	08/09/89	2	IGH	06-59-28	08/16/89	2	IGH
06-59-29	08/09/89	22	IGH	06-59-29	08/16/89	88	IGH
06-59-34	08/09/89	2	IGH	06-59-34	08/16/89	6	IGH
06-63-03	08/09/89	4	IGH	06-59-35	08/16/89	2	IGH
06-63-04	08/09/89	2	IGH	06-63-03	08/16/89	24	IGH
06-63-05	08/09/89	6	IGH	06-63-04	08/16/89	14	IGH
06-63-06	08/09/89	2	IGH	06-63-05	08/16/89	12	IGH
06-63-07	08/09/89	6	IGH	06-63-06	08/16/89	10	IGH
06-63-08	08/09/89	2	IGH	06-63-07	08/16/89	12	IGH
06-63-09	08/09/89	4	IGH	06-63-08	08/16/89	10	IGH
06-63-18	08/09/89	6	IGH	06-63-09	08/16/89	40	IGH
B6-08-06	08/09/89	2	SHASTA	06-63-18	08/16/89	10	IGH
06-59-27	08/10/89	2	IGH	06-63-32	08/16/89	4	IGH
06-59-29	08/10/89	16	IGH	B6-08-06	08/16/89	2	SHASTA
06-59-34	08/10/89	2	IGH	B6-08-10	08/16/89	4	SHASTA
06-63-05	08/10/89	2	IGH	06-59-27	08/17/89	6	IGH
06-63-06	08/10/89	6	IGH	06-59-28	08/17/89	2	IGH
06-63-18	08/10/89	2	IGH	06-59-29	08/17/89	40	IGH
06-63-32	08/10/89	2	IGH	06-59-34	08/17/89	2	IGH
B6-08-06	08/10/89	2	SHASTA	06-59-60	08/17/89	2	IGH
06-59-27	08/11/89	2	IGH	06-63-04	08/17/89	2	IGH
06-59-29	08/11/89	16	IGH	06-63-05	08/17/89	6	IGH
06-63-02	08/11/89	4	IGH	06-63-07	08/17/89	2	IGH
06-63-03	08/11/89	6	IGH	06-63-08	08/17/89	4	IGH
06-63-04	08/11/89	2	IGH	06-63-09	08/17/89	2	IGH
06-63-05	08/11/89	2	IGH	06-63-18	08/17/89	2	IGH
06-63-06	08/11/89	10	IGH	06-63-32	08/17/89	4	IGH
06-63-07	08/11/89	2	IGH	06-59-27	08/18/89	2	IGH
06-63-08	08/11/89	2	IGH	06-59-28	08/18/89	2	IGH
06-63-09	08/11/89	4	IGH	06-59-29	08/18/89	20	IGH
06-63-18	08/11/89	4	IGH	06-59-34	08/18/89	4	IGH
06-59-27	08/12/89	4	IGH	06-63-02	08/18/89	2	IGH
06-59-29	08/12/89	34	IGH	06-63-03	08/18/89	10	IGH
06-59-34	08/12/89	4	IGH	06-63-04	08/18/89	4	IGH
06-63-03	08/12/89	6	IGH	06-63-05	08/18/89	4	IGH
06-63-04	08/12/89	6	IGH	06-63-06	08/18/89	4	IGH
06-63-05	08/12/89	2	IGH	06-63-07	08/18/89	8	IGH
06-63-06	08/12/89	6	IGH	06-63-09	08/18/89	4	IGH
06-63-07	08/12/89	2	IGH	06-63-18	08/18/89	4	IGH
06-63-08	08/12/89	4	IGH	06-63-32	08/18/89	2	IGH
06-63-09	08/12/89	12	IGH	06-59-27	08/19/89	2	IGH
06-63-18	08/12/89	2	IGH	06-59-29	08/19/89	12	IGH
06-63-32	08/12/89	2	IGH	06-59-34	08/19/89	2	IGH
06-59-22	08/13/89	4	IGH	06-63-03	08/19/89	2	IGH
06-59-27	08/13/89	2	IGH	06-63-18	08/19/89	2	IGH
06-59-29	08/13/89	74	IGH	06-59-22	08/20/89	2	IGH
06-59-34	08/13/89	6	IGH	06-59-29	08/20/89	36	IGH
06-63-02	08/13/89	2	IGH	06-59-34	08/20/89	4	IGH
06-63-03	08/13/89	18	IGH	06-59-35	08/20/89	2	IGH

NOTE: These recoveries have not been expanded for sampling or untagged fish.

CWT Code	Date	# Caught	Stock
06-59-60	08/20/89	2	IGH
06-63-02	08/20/89	2	IGH
06-63-04	08/20/89	4	IGH
06-63-05	08/20/89	8	IGH
06-63-08	08/20/89	6	IGH
06-63-09	08/20/89	10	IGH
06-63-18	08/20/89	2	IGH
B6-08-06	08/20/89	4	SHASTA
06-59-22	08/23/89	4	IGH
06-59-27	08/23/89	4	SHASTA
06-59-29	08/23/89	66	IGH
06-59-34	08/23/89	4	IGH
06-59-42	08/23/89	2	IGH
06-59-60	08/23/89	2	IGH
06-63-02	08/23/89	2	IGH
06-63-03	08/23/89	18	IGH
06-63-04	08/23/89	6	IGH
06-63-05	08/23/89	8	IGH
06-63-06	08/23/89	18	IGH
06-63-07	08/23/89	24	IGH
06-63-08	08/23/89	12	IGH
06-63-09	08/23/89	14	IGH
06-63-18	08/23/89	10	IGH
06-63-32	08/23/89	2	IGH
06-59-29	08/24/89	22	IGH
06-63-03	08/24/89	2	IGH
06-63-04	08/24/89	2	IGH
06-63-05	08/24/89	4	IGH
06-63-06	08/24/89	4	IGH
06-63-07	08/24/89	10	IGH
06-63-08	08/24/89	2	IGH
06-63-09	08/24/89	14	IGH
06-63-18	08/24/89	6	IGH
06-63-32	08/24/89	2	IGH
06-59-22	08/25/89	2	IGH
06-59-28	08/25/89	2	IGH
06-59-29	08/25/89	48	IGH
06-59-34	08/25/89	6	IGH
06-59-60	08/25/89	2	IGH
06-63-02	08/25/89	2	IGH
06-63-03	08/25/89	6	IGH
06-63-04	08/25/89	4	IGH
06-63-05	08/25/89	8	IGH
06-63-06	08/25/89	2	IGH
06-63-07	08/25/89	6	IGH
06-63-08	08/25/89	12	IGH
06-63-09	08/25/89	12	IGH
06-63-18	08/25/89	2	IGH
06-63-32	08/25/89	2	IGH
B6-08-10	08/25/89	2	SHASTA
06-59-22	08/26/89	2	IGH
06-59-27	08/26/89	8	IGH
06-59-28	08/26/89	2	IGH
06-59-29	08/26/89	74	IGH
06-59-34	08/26/89	4	IGH
06-59-35	08/26/89	2	IGH
06-63-02	08/26/89	2	IGH
06-63-03	08/26/89	12	IGH
06-63-04	08/26/89	14	IGH
06-63-05	08/26/89	14	IGH
06-63-06	08/26/89	14	IGH
06-63-07	08/26/89	14	IGH
06-63-08	08/26/89	6	IGH
06-63-09	08/26/89	20	IGH
06-63-18	08/26/89	10	IGH

CWT Code	Date	# Caught	Stock
B6-08-05	08/26/89	2	SHASTA
06-59-22	08/27/89	6	IGH
06-59-28	08/27/89	2	IGH
06-59-29	08/27/89	62	IGH
06-59-34	08/27/89	6	IGH
06-63-03	08/27/89	10	IGH
06-63-04	08/27/89	8	IGH
06-63-05	08/27/89	6	IGH
06-63-06	08/27/89	12	IGH
06-63-07	08/27/89	16	IGH
06-63-08	08/27/89	10	IGH
06-63-09	08/27/89	22	IGH
06-63-18	08/27/89	4	IGH
06-63-32	08/27/89	2	IGH
B6-08-10	08/27/89	2	SHASTA
06-59-22	08/30/89	6	IGH
06-59-28	08/30/89	4	IGH
06-59-29	08/30/89	120	IGH
06-59-34	08/30/89	10	IGH
06-59-42	08/30/89	2	IGH
06-63-02	08/30/89	4	IGH
06-63-03	08/30/89	26	IGH
06-63-04	08/30/89	18	IGH
06-63-05	08/30/89	14	IGH
06-63-06	08/30/89	24	IGH
06-63-07	08/30/89	16	IGH
06-63-08	08/30/89	10	IGH
06-63-09	08/30/89	20	IGH
06-63-18	08/30/89	14	IGH
06-63-32	08/30/89	6	IGH
B6-08-10	08/30/89	2	SHASTA
06-63-06	09/02/89	1	IGH

NOTE: These recoveries have not been expanded for sampling or untagged fish.